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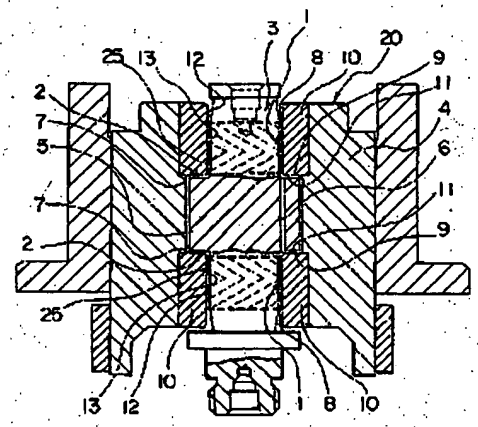
(54)【発明の名称】　スピンドル

(57)【要約】
【課題】　本発明は、同じ寸法高さのスピンドルにおいては、2ヵ所のラジアル流体軸受のスパンを広げてモーメント剛性を高めるとともに、使用中や高速回転中の潤滑剤のもれや飛散が少ないスピンドルを提供することを目的としている。
【解決手段】　軸受部材の内周に軸部材を配設し、軸部材に設けたフランジは平面状のスラスト受面を有し、軸部材はフランジの軸方向両側に円筒状のラジアル受面を有し、軸受部材はスラスト受面に対向するスラスト軸受面とラジアル受面にラジアル軸受すきまを介して対向するラジアル軸受面とを有し、フランジの軸方向両側のラジアル軸受すきまのフランジ側の部分は軸部材に設けた連通孔を介して互いに連通している。



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【特許請求の範囲】

【請求項1】　軸受部材の内周に軸部材を配設し、

前記軸部材に設けたフランジは平面状のスラスト受面を有し、

前記軸部材は前記フランジの軸方向両側に円筒状のラジアル受面を有し、

前記軸受部材は前記スラスト受面に対向するスラスト軸受面と、前記ラジアル受面にラジアル軸受すきまを介して対向するラジアル軸受面とを有し、

前記フランジの軸方向両側の前記ラジアル軸受すきまの前記フランジ側の部分は軸部材に設けた連通孔を介して互いに連通しているスピンドル。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】情報機器、音響・映像機器用スピンドル、とくに磁気ディスク装置に最適なスピンドルに関する。

【0002】

【従来の技術】従来、ディスク用スピンドルは、図3のような構造となっている。すなわち、ディスク50を搭載した軸受部材51が2ヵ所のラジアル流体軸受52と2ヵ所のラジアル流体軸受52より上方に位置する2ヵ所のスラスト流体軸受53とによって回転自在に軸部材54に支持され、軸受部材51に固定したロータ55および軸部材54に固定したステータ56からなるモータMにより軸受部材51は回転駆動される。

【0003】

【発明が解決しようとする課題】磁気ディスク装置では、高容量・高記録密度化が進展しており、そこに使用されるスピンドルモータには非回転同期成分の振れが小さいことはもちろんのこと、ヘッドの追従性を高めるためにディスク外周面のアキシアル方向の振れを小さくすることが求められている。非回転同期成分の振れを小さくするには、流体軸受を用いたスピンドルが適しているが、スピンドルのモーメント剛性が玉軸受を用いたスピンドルに比較して小さいという欠点がある。一方、高容量化のためにディスク枚数が多くなると、ディスク外周面のアキシアル方向の振れを小さくするには、スピンドルのモーメント剛性を高くする必要がある。しかしながら、図3のようにスラスト流体軸受53を2ヵ所のラジアル流体軸受52の外側（上側）に配置すると、2ヵ所のラジアル流体軸受52間のスパンが小さくなり、モーメント剛性が大きく設計できないという問題がある。また、図3の構造では、スラスト流体軸受53がスピンドルの外面と連通するのでスラスト流体軸受53の潤滑剤が回転中の遠心力により軸方向外側に向かって飛散しやすいという問題があった。

【0004】本発明は、以上のような問題点に着目し、同じ寸法高さのスピンドルにおいては、2ヵ所のラジアル流体軸受のスパンを広げてモーメント剛性を高めるとともに、使用中や高速回転中の潤滑剤のもれや飛散が少ないスピンドルを提供することを目的としている。

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【0005】

【課題を解決するための手段】軸受部材の内周に軸部材を配設し、軸部材に設けたフランジは平面状のスラスト受面を有し、軸部材はフランジの軸方向両側に円筒状のラジアル受面を有し、軸受部材はスラスト受面に対向するスラスト軸受面とラジアル受面にラジアル軸受すきまを介して対向するラジアル軸受面とを有し、フランジの軸方向両側のラジアル軸受すきまのフランジ側の部分は軸部材に設けた連通孔を介して互いに連通している。

【0006】

【実施例】図1に第1の実施例を示す。円筒部材4の内周面の軸方向両端部にはスリーブ10がそれぞれ嵌合して固定され、この一対のスリーブ10と円筒部材4とは軸受部材20を構成する。前記軸受部材20の内周に軸部材3を配設し、この軸部材3の軸方向中間部にはフランジ5が設けられている。前記フランジ5は軸方向両面に平面状のスラスト受面9をそれぞれ有し、また軸部材3はフランジ5の軸方向両側に円筒状のラジアル受面12をそれぞれ有している。前記軸受部材20はスラスト受面9にスラスト軸受すきま7を介して対向するスラスト軸受面11とラジアル受面12にラジアル軸受すきま8を介して対向するラジアル軸受面13とをそれぞれ有している。前記ラジアル軸受面13にはヘリングボーン状の動圧発生用の溝25がそれぞれ設けられ、また図示されてはいないがスラスト軸受面11にはヘリングボーン状の動圧発生用の溝がそれぞれ設けられている。互いに対向するラジアル軸受面13とラジアル受面12とはラジアル流体軸受1を構成し、また互いに対向するスラスト軸受面11とスラスト受面9とはスラスト流体軸受2を構成する。

【0007】軸部材3は2ヵ所のラジアル流体軸受1と、その間に設けた2ヵ所のスラスト流体軸受2とを介して軸受部材20を回転自在に支持している。このため、2ヵ所のラジアル流体軸受1間のスパンが広く取れるので、モーメント剛性が高い。軸部材3に設けられた連通孔6はフランジ5の軸方向両側のラジアル軸受すきま8のフランジ5側の部分を互いに連通しており、使用中にフランジ5の両側に設けたスラスト流体軸受2のスラスト軸受すきま7内の潤滑剤の圧力差にもとづく潤滑剤の軸方向外方へのもれを防止している。すなわち、連通孔6が設けられていないと、軸受部材20の回転時に下方にアキシアル荷重が負荷されると上方のスラスト軸受すきま7の圧力が下方のスラスト軸受すきま7の圧力よりも高くなり上方のラジアル軸受すきま8の潤滑剤が全体の圧力が平衡するまで上方又は下方へもれる。連通孔6がないと、使用姿勢の変化によりアキシアル荷重が変化することにフランジ5の軸方向両側のスラスト軸受すきま7の圧力差が変化して潤滑剤がもれてゆくので、

長期の使用により潤滑剤が枯渇してしまうが、本発明ではこのような潤滑剤のもれを完全に防止できる。

【０００８】この実施例では、スラスト流体軸受２のスラスト受面９を軸のフランジ５の軸方向の両面に設けており、スリーブ１０には、スラスト受面９に対向するスラスト軸受面１１が設けられているので、外部衝撃や外部振動がかかってもスピンドルは使用姿勢の制約を受けない利点がある。なお、フランジ５を軸部材３と一体とすると加工精度が向上し、軸心とフランジ５の平面状のスラスト受面９との直角度が確保しやすくスラスト受面９とスラスト軸受面１１との片あたりが防止でき、起動停止耐久性が向上するので好ましい。

【０００９】次に、第２の実施例について説明する。図２では、軸２４の軸方向中間部にフランジ５を嵌合して固定している。フランジ５を軸２４と別体として、軸２４に圧入または接着により固着しており、フランジ５と軸２４とを軸部材３は備えている。また、軸部材３のフランジ５の内径面と軸２４の外径面との間には、フランジ５の軸方向両側のラジアル軸受すきま８のフランジ５側の部分を互いに連通する潤滑剤の連通孔６が設けられている。軸部材３の一方の端面に連通孔６へ連通する給油穴２６を設けている。この給油穴２６には給油穴２６より連通孔６へ潤滑剤注入後に栓２８をして潤滑剤の外部へのもれを防止している。

【００１０】なお、軸部材３と軸受部材２０とのいずれか一方に固定したロータとロータに半径方向に対向して他方に固定されたステータとの軸方向位置をずらしたり、補助の磁気軸受を設けることにより軸部材３と軸受部材２０とに軸方向の磁気吸引力を作用させ、フランジ５の片面のみにアキシアル荷重がかかるように設計して、フランジ５の片面のみをスラスト流体軸受２のスラスト受面９とすることもできる。この場合は、フランジ５の他方のスラスト受面９は、抜け止めとして機能するだけで、アキシアル荷重は受けない。この場合は、使用姿勢に対して耐えられる外部衝撃や外部振動の大きさに制約がでるが、動圧発生用の溝をフランジ５の軸方向の一方のスラスト受面９とスラスト軸受面１１との少なくとも一方のみに設けるだけで済む利点がある。

【００１１】また、スラスト流体軸受２の動圧発生用の溝は互いに対向するスラスト受面９とスラスト軸受面１１との少なくとも一方に設け、ラジアル流体軸受１の動圧発生用の溝は、互いに対向するラジアル受面１２とラジアル軸受面１３との少なくとも一方に設けている。また、本発明は軸受部材２０回転でも軸部材３回転でもよい。なお、本発明では、２ヵ所のラジアル流体軸受１の間にスラスト流体軸受２を設けたため、スラスト流体軸受２の潤滑剤はスラスト流体軸受２の両側に設けたラジアル流体軸受によってシールされるため、回転中に遠心力が作用しても潤滑剤がスピンドルの外方へ飛散することが防止され、耐久性が向上する。

【００１２】

【発明の効果】本発明によると、スラスト流体軸受が２ヵ所のラジアル流体軸受に挟まれており、２ヵ所のラジアル流体軸受のスパンが広く取れるので、スピンドルのモーメント剛性が向上し、スピンドルの外周部のアキシアル方向の振れを小さくできる。また、スラスト軸受すきまはラジアル流体軸受の自己シール機能によりシールされるため、使用中の潤滑剤のもれが防止でき、高速回転中の潤滑剤の飛散が少なく耐久性に優れる。また、軸部材にはフランジの軸方向両側のラジアル軸受すきまのフランジ側の部分を連通する潤滑剤の連通孔を設けて、使用中のフランジの軸方向両側面近傍に生ずる圧力差を少なくするようにして、潤滑剤のスピンドルの外部へのもれを防止している。

【図面の簡単な説明】

【図１】本発明の第１の実施例を示す図である。

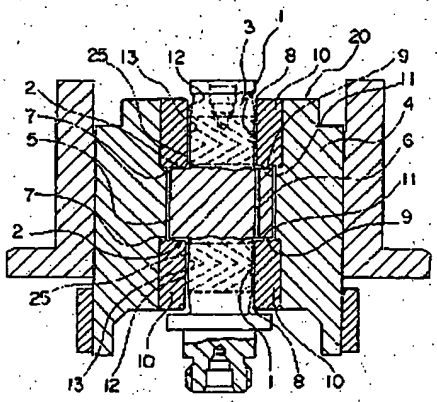
【図２】本発明の第２の実施例を示す図である。

【図３】従来例を示す図である。

【符号の説明】

１　ラジアル流体軸受
２　スラスト流体軸受
３　軸部材
４　円筒部材
５　フランジ
６　連通孔
７　スラスト軸受すきま
８　ラジアル軸受すきま
９　スラスト受面
１０　スリーブ
１１　スラスト軸受面
１２　ラジアル受面
１３　ラジアル軸受面
２０　軸受部材

【図1】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2
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12
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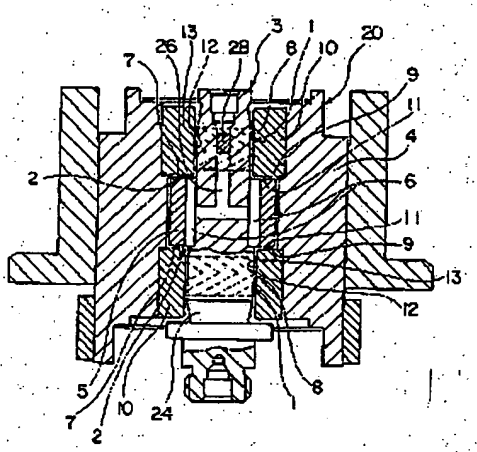
1
8
10

【図2】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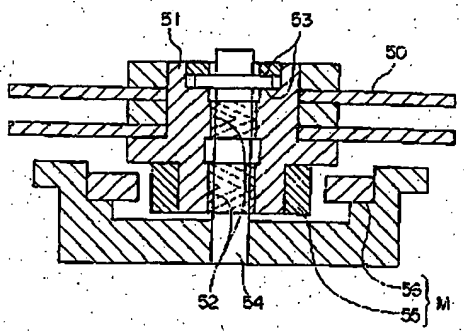
24
1
8

【図3】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M

CLAIMS

[Claim(s)]
[Claim 1] Arrange shank material in the inner circumference of bearing material, and the flange prepared in the aforementioned shank material has the thrust abutment of a plane. The thrust bearing side where the aforementioned shank material has a cylinder-like radial abutment on shaft-orientations both sides of the aforementioned flange, and the aforementioned bearing material counters the aforementioned thrust abutment, It is the spindle which has the radial bearing side which counters the aforementioned radial abutment through a radial bearing crevice, and is mutually open for free passage through the run through-hole which prepared the portion by the side of the aforementioned flange of the aforementioned radial bearing crevice between the shaft-orientations both sides of the aforementioned flange in shank material.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] It is related with the spindle for information machines and equipment and audiovisual equipments, especially the optimal spindle for a magnetic disk unit.
[0002]
[Description of the Prior Art] Conventionally, the spindle for disks has structure like drawing 3 . That is, the bearing material 51 which carried the disk 50 is supported free [rotation] by two radial liquid bearings 52 and two thrust liquid bearings 53 located more nearly up than two radial liquid bearings 52 at the shank material 54, and the rotation drive of the bearing material 51 is carried out by the motor M which consists of a stator 56 fixed to Rota 55 and the shank material 54 which were fixed to the bearing material 51.
[0003]
[Problem(s) to be Solved by the Invention] In the magnetic disk unit, high capacity and quantity recording density-ization are progressing, and in order that the deflection of a nonrotation synchronous component may raise the flattery nature of a head to the spindle motor used there not to mention a small thing, making small the deflection of the direction of an axial bond of a disk peripheral face is called for. Although the spindle using the liquid bearing is suitable in order to make the deflection of a nonrotation synchronous component small, there is a fault that it is small as compared with the spindle [rigidity / moment / of a spindle] using the ball bearing. On the other hand, if disk number of sheets increases for high-capacity-izing, in order to make small the deflection of the direction of an axial bond of

a disk peripheral face, it is necessary to make moment rigidity of a spindle high. However, when the thrust liquid bearing 53 is arranged on the outside (above) of two radial liquid bearings 52 like drawing 3 , the span between two radial liquid bearings 52 becomes small, and there is a problem that moment rigidity cannot design greatly. Moreover, with the structure of drawing 3 , since the thrust liquid bearing 53 was open for free passage with the superficies of a spindle, there was a problem of being easy to disperse with the centrifugal force which the lubricant of the thrust liquid bearing 53 is rotating toward a shaft-orientations outside.

[0004] this invention aims at a leak and scattering of the lubricant under use and high-speed rotation offering a few spindle while it extends the span of two radial liquid bearings and raises moment rigidity in the spindle of the same size height paying attention to the above troubles.

[0005]

[Means for Solving the Problem] Arrange shank material in the inner circumference of bearing material, and the flange prepared in shank material has the thrust abutment of a plane. Shank material has a cylinder-like radial abutment on shaft-orientations both sides of a flange, and bearing material has the thrust bearing side which counters a thrust abutment, and the radial bearing side which counters a radial abutment through a radial bearing crevice. The portion by the side of the flange of the radial bearing crevice between the shaft-orientations both sides of a flange is mutually open for free passage through the run through-hole prepared in shank material.

[0006]

[Example] The 1st example is shown in drawing 1 . A sleeve 10 fits into the shaft-orientations both ends of the inner skin of the body material 4, respectively, it is fixed, and the sleeve 10 and the body material 4 of this couple constitute the bearing material 20. The shank material 3 is arranged in the inner circumference of the aforementioned bearing material 20, and the flange 5 is formed in the shaft-orientations pars intermedia of this shank material 3. The aforementioned flange 5 has the thrust abutment 9 of a plane to shaft-orientations both sides, respectively, and the shank material 3 has the cylinder-like radial abutment 12 on shaft-orientations both sides of a flange 5, respectively. The aforementioned bearing material 20 has the thrust bearing side 11 which counters the thrust abutment 9 through the thrust bearing crevice 7, and the radial bearing side 13 which counters the radial abutment 12 through the radial bearing crevice 8, respectively. Although the slot 25 for herringbone-like generating [dynamic pressure] is established in the aforementioned radial bearing side 13, respectively and it is not illustrated, the slot for herringbone-like generating [dynamic pressure] is established in the thrust bearing side 11, respectively. The thrust bearing side 11 and the thrust abutment 9 which the radial bearing side 13 and the radial abutment 12 which counter mutually constitute the radial liquid bearing 1, and counter mutually constitute the thrust liquid bearing 2.

[0007] The shank material 3 is supporting the bearing material 20 free [rotation] through two radial liquid bearings 1 and two thrust liquid bearings 2 prepared between them. For this reason, since the large span between two radial liquid bearings 1 can be taken, moment rigidity is high. The run through-hole 6 prepared in the shank material 3 is opening mutually the portion by the side of the flange 5 of the radial bearing crevice 8 between the shaft-orientations both sides of a flange 5 for free passage, and has prevented the leak by the method of the outside of shaft orientations of the lubricant based on the pressure differential of the lubricant in the thrust bearing crevice 7 between the thrust liquid bearings 2 prepared while in use at the both sides of a flange 5. That is, if the run through-hole 6 is not formed and the load of the axial-bond load will be carried out to a lower part at the time of rotation of the bearing material 20, the pressure of the upper thrust bearing crevice 7 becomes higher than the pressure of the thrust bearing crevice 7 between downward, and the lubricant of the upper

radial bearing crevice 8 will leak to the upper part or a lower part until the whole pressure balances. Since the pressure differential of the thrust bearing crevice 7 between the shaft-orientations both sides of a flange 5 will change and lubricant will leak, whenever an axial-bond load changes with change of a use posture, if there is no run through-hole 6, although lubricant will be drained with long-term use, in this invention, the leak of such lubricant can be prevented completely.

[0008] In this example, since the thrust abutment 9 of the thrust liquid bearing 2 is established in both sides of the shaft orientations of the flange 5 of a shaft and the thrust bearing side 11 which counters the thrust abutment 9 is established in the sleeve 10, even if an external shock and extraneous vibration start, a spindle has the advantage which does not receive restrictions of a use posture. In addition, since a process tolerance improves, per [of the thrust abutment 9 and the thrust bearing side 11] piece can be prevented that it is easy to secure the squareness of an axial center and the thrust abutment 9 of the plane of a flange 5 and deactivation endurance will improve if a flange 5 is made into the shank material 3 and one, it is desirable.

[0009] Next, the 2nd example is explained. The flange 5 is fitted in and fixed to the shaft-orientations pars intermedia of a shaft 24 in drawing 2 . The flange 5 is fixed by pressing fit or adhesion on the shaft 24 as a shaft 24 and another object, and the shank material 3 is equipped with the flange 5 and the shaft 24. Moreover, between the bore side of the flange 5 of the shank material 3, and the outer-diameter side of a shaft 24, the run through-hole 6 of the lubricant which opens mutually the portion by the side of the flange 5 of the radial bearing crevice 8 between the shaft-orientations both sides of a flange 5 for free passage is formed. The oil supply hole 26 which is open for free passage to the run through-hole 6 is established in one end face of the shank material 3. The plug 28 was made this oil supply hole 26 from the oil supply hole 26 after lubricant pouring to the run through-hole 6, and the leak by the exterior of lubricant is prevented.

[0010] in addition, shift a shaft-orientations position with the stator which countered radial in Rota and Rota which were fixed to either of the shank material 3 and the bearing material 20, and was fixed to another side, or By preparing an auxiliary magnetic bearing, the magnetic-attraction force of shaft orientations can be made to be able to act on the shank material 3 and the bearing material 20, it can design so that an axial-bond load may be applied only to one side of a flange 5, and also let only one side of a flange 5 be the thrust abutment 9 of the thrust liquid bearing 2. In this case, it escapes from the thrust abutment 9 of another side of a flange 5, it only functions as a stop, and does not receive an axial-bond load. In this case, although restrictions appear in the size of the external shock and extraneous vibration which can be borne to a use posture, there is an advantage which needs to establish the slot for dynamic pressure generating only at least in one side of one thrust abutment 9 of the shaft orientations of a flange 5 and the thrust bearing side 11.

[0011] Moreover, the slot for dynamic pressure generating of the thrust liquid bearing 2 was established at least in one side of the thrust abutment 9 and the thrust bearing side 11 which counter mutually, and the slot for dynamic pressure generating of the radial liquid bearing 1 is established at least in one side of the radial abutment 12 and the radial bearing side 13 which counter mutually. Moreover, bearing material 20 rotations or shank material 3 rotations are sufficient as this invention. In addition, in this invention, since a seal is carried out by the radial liquid bearing which prepared the lubricant of the thrust liquid bearing 2 in the both sides of the thrust liquid bearing 2 since the thrust liquid bearing 2 was formed between two radial liquid bearings 1, even if a centrifugal force acts during rotation, it is prevented that lubricant disperses to a way outside a spindle, and endurance improves.

[0012]

[Effect of the Invention] Since according to this invention the thrust liquid bearing is inserted into two radial liquid bearings and the large span of two radial liquid bearings can be taken, the moment rigidity of a spindle improves and the deflection of the direction of an axial bond

of the periphery section of a spindle can be made small. Moreover, since the seal of the thrust bearing crevice is carried out by the self-seal function of a radial liquid bearing, it can prevent the leak of lubricant in use, and scattering of the lubricant under high-speed rotation is excellent in endurance few. Moreover, as the run through-hole of the lubricant which opens the portion by the side of the flange of the radial bearing crevice between the shaft-orientations both sides of a flange for free passage was prepared in shank material and the pressure differential produced near the shaft-orientations both-sides side of a flange in use was lessened, the leak by the exterior of the spindle of lubricant is prevented.

[Translation done.]

TECHNICAL FIELD

[The technical field to which invention belongs] It is related with the spindle for information machines and equipment and audiovisual equipments, especially the optimal spindle for a magnetic disk unit.

PRIOR ART

[Description of the Prior Art] Conventionally, the spindle for disks has structure like drawing 3 . That is, the bearing material 51 which carried the disk 50 is supported free [rotation] by two radial liquid bearings 52 and two thrust liquid bearings 53 located more nearly up than two radial liquid bearings 52 at the shank material 54, and the rotation drive of the bearing material 51 is carried out by the motor M which consists of a stator 56 fixed to Rota 55 and the shank material 54 which were fixed to the bearing material 51.

[Translation done

EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention the thrust liquid bearing is inserted into two radial liquid bearings and the large span of two radial liquid bearings can be taken, the moment rigidity of a spindle improves and the deflection of the direction of an axial bond of the periphery section of a spindle can be made small. Moreover, since the seal of the thrust bearing crevice is carried out by the self-seal function of a radial liquid bearing, it can prevent the leak of lubricant in use, and scattering of the lubricant under high-speed rotation is excellent in endurance few. Moreover, as the run through-hole of the lubricant which opens the portion by the side of the flange of the radial bearing crevice between the shaft-orientations both sides of a flange for free passage was prepared in shank material and the pressure differential produced near the shaft-orientations both-sides side of a flange in use was lessened, the leak by the exterior of the spindle of lubricant is prevented.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the magnetic disk unit, high capacity and quantity recording density-ization are progressing, and in order that the deflection of a nonrotation synchronous component may raise the flattery nature of a head to the spindle motor used there not to mention a small thing, making small the deflection of the direction of an axial bond of a disk peripheral face is called for. Although the spindle using the liquid bearing is suitable in order to make the deflection of a nonrotation synchronous component small, there is a fault that it is small as compared with the spindle [rigidity / moment / of a spindle] using the ball bearing. On the other hand, if disk number of sheets increases for high-capacity-izing, in order to make small the deflection of the direction of an axial bond of a disk peripheral face, it is necessary to make moment rigidity of a spindle high. However, when the thrust liquid bearing 53 is arranged on the outside (above) of two radial liquid bearings 52 like drawing 3 , the span between two radial liquid bearings 52 becomes small, and there is a problem that moment rigidity cannot design greatly. Moreover, with the structure of drawing 3 , since the thrust liquid bearing 53 was open for free passage with the superficies of a spindle, there was a problem of being easy to disperse with the centrifugal force which the lubricant of the thrust liquid bearing 53 is rotating toward a shaft-orientations outside.

[0004] this invention aims at a leak and scattering of the lubricant under use and high-speed rotation offering a few spindle while it extends the span of two radial liquid bearings and raises moment rigidity in the spindle of the same size height paying attention to the above troubles.

[Translation done.]

MEANS

[Means for Solving the Problem] Arrange shank material in the inner circumference of bearing material, and the flange prepared in shank material has the thrust abutment of a plane. Shank material has a cylinder-like radial abutment on shaft-orientations both sides of a flange, and bearing material has the thrust bearing side which counters a thrust abutment, and the radial bearing side which counters a radial abutment through a radial bearing crevice. The portion by the side of the flange of the radial bearing crevice between the shaft-orientations both sides of a flange is mutually open for free passage through the run through-hole prepared in shank material.

[Translation done.]

EXAMPLE

[Example] The 1st example is shown in drawing 1 . A sleeve 10 fits into the shaft-orientations both ends of the inner skin of the body material 4, respectively, it is fixed, and the sleeve 10 and the body material 4 of this couple constitute the bearing material 20. The shank material 3 is arranged in the inner circumference of the aforementioned bearing material 20, and the flange 5 is formed in the shaft-orientations pars intermedia of this shank material 3. The

aforementioned flange 5 has the thrust abutment 9 of a plane to shaft-orientations both sides, respectively, and the shank material 3 has the cylinder-like radial abutment 12 on shaft-orientations both sides of a flange 5, respectively. The aforementioned bearing material 20 has the thrust bearing side 11 which counters the thrust abutment 9 through the thrust bearing crevice 7, and the radial bearing side 13 which counters the radial abutment 12 through the radial bearing crevice 8, respectively. Although the slot 25 for herringbone-like generating [dynamic pressure] is established in the aforementioned radial bearing side 13, respectively and it is not illustrated, the slot for herringbone-like generating [dynamic pressure] is established in the thrust bearing side 11, respectively. The thrust bearing side 11 and the thrust abutment 9 which the radial bearing side 13 and the radial abutment 12 which counter mutually constitute the radial liquid bearing 1, and counter mutually constitute the thrust liquid bearing 2.

[0007] The shank material 3 is supporting the bearing material 20 free [rotation] through two radial liquid bearings 1 and two thrust liquid bearings 2 prepared between them. For this reason, since the large span between two radial liquid bearings 1 can be taken, moment rigidity is high. The run through-hole 6 prepared in the shank material 3 is opening mutually the portion by the side of the flange 5 of the radial bearing crevice 8 between the shaft-orientations both sides of a flange 5 for free passage, and has prevented the leak by the method of the outside of shaft orientations of the lubricant based on the pressure differential of the lubricant in the thrust bearing crevice 7 between the thrust liquid bearings 2 prepared while in use at the both sides of a flange 5. That is, if the run through-hole 6 is not formed and the load of the axial-bond load will be caudad carried out at the time of rotation of the bearing material 20, the pressure of the upper thrust bearing crevice 7 becomes higher than the pressure of the thrust bearing crevice 7 between downward, and the lubricant of the upper radial bearing crevice 8 will leak to the upper part or a lower part until the whole pressure balances. Since the pressure differential of the thrust bearing crevice 7 between the shaft-orientations both sides of a flange 5 will change and lubricant will leak, whenever an axial-bond load changes with change of a use posture, if there is no run through-hole 6, although lubricant will be drained with long-term use, in this invention, the leak of such lubricant can be prevented completely.

[0008] In this example, since the thrust abutment 9 of the thrust liquid bearing 2 is established in both sides of the shaft orientations of the flange 5 of a shaft and the thrust bearing side 11 which counters the thrust abutment 9 is established in the sleeve 10, even if an external shock and extraneous vibration start, a spindle has the advantage which does not receive restrictions of a use posture. In addition, since a process tolerance improves, per [of the thrust abutment 9 and the thrust bearing side 11] piece can be prevented that it is easy to secure the squareness of an axial center and the thrust abutment 9 of the plane of a flange 5 and deactivation endurance will improve if a flange 5 is made into the shank material 3 and one, it is desirable.

[0009] Next, the 2nd example is explained. The flange 5 is fitted in and fixed to the shaft-orientations pars intermedia of a shaft 24 in drawing 2 . The flange 5 is fixed by pressing fit or adhesion on the shaft 24 as a shaft 24 and another object, and the shank material 3 is equipped with the flange 5 and the shaft 24. Moreover, between the bore side of the flange 5 of the shank material 3, and the outer-diameter side of a shaft 24, the run through-hole 6 of the lubricant which opens mutually the portion by the side of the flange 5 of the radial bearing crevice 8 between the shaft-orientations both sides of a flange 5 for free passage is formed. The oil supply hole 26 which is open for free passage to the run through-hole 6 is established in one end face of the shank material 3. The plug 28 was made this oil supply hole 26 from the oil supply hole 26 after lubricant pouring to the run through-hole 6, and the leak by the exterior of lubricant is prevented.

[0010] in addition, shift a shaft-orientations position with the stator which countered radial in Rota and Rota which were fixed to either of the shank material 3 and the bearing material 20,

and was fixed to another side, or By preparing an auxiliary magnetic bearing, the magnetic-attraction force of shaft orientations can be made to be able to act on the shank material 3 and the bearing material 20, it can design so that an axial-bond load may be applied only to one side of a flange 5, and also let only one side of a flange 5 be the thrust abutment 9 of the thrust liquid bearing 2. In this case, it escapes from the thrust abutment 9 of another side of a flange 5, it only functions as a stop, and does not receive an axial-bond load. In this case, although restrictions appear in the size of the external shock and extraneous vibration which can be borne to a use posture, there is an advantage which needs to establish the slot for dynamic pressure generating only at least in one side of one thrust abutment 9 of the shaft orientations of a flange 5 and the thrust bearing side 11.

[0011] Moreover, the slot for dynamic pressure generating of the thrust liquid bearing 2 was established at least in one side of the thrust abutment 9 and the thrust bearing side 11 which counter mutually, and the slot for dynamic pressure generating of the radial liquid bearing 1 is established at least in one side of the radial abutment 12 and the radial bearing side 13 which counter mutually. Moreover, bearing material 20 rotations or shank material 3 rotations are sufficient as this invention. In addition, in this invention, since a seal is carried out by the radial liquid bearing which prepared the lubricant of the thrust liquid bearing 2 in the both sides of the thrust liquid bearing 2 since the thrust liquid bearing 2 was formed between two radial liquid bearings 1, even if a centrifugal force acts during rotation, it is prevented that lubricant disperses to a way outside a spindle, and endurance improves.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the 1st example of this invention.

[Drawing 2] It is drawing showing the 2nd example of this invention.

[Drawing 3] It is drawing showing the conventional example.

[Description of Notations]

1 Radial Liquid Bearing
2 Thrust Liquid Bearing
3 Shank Material
4 Body Material
5 Flange
6 Run Through-hole
7 Thrust Bearing Crevice
8 Radial Bearing Crevice
9 Thrust Abutment
10 Sleeve
11 Thrust Bearing Side
12 Radial Abutment
13 Radial Bearing Side
20 Bearing Material

[Translation done.]

DRAWINGS

[Drawing 1]